

SURFICIAL GEOLOGIC MAP OF THE SOUTHWEST MEMPHIS QUADRANGLE, SHELBY COUNTY, TENNESSEE, AND CRITTENDEN COUNTY, ARKANSAS

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Institute, University of Memphis. Total depth of holes exceeds the vertical

dimension of the cross section and is not plotted

and does not imply endorsement by the U.S. Government

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iron oxide-cemented sand structures (root casts?, burrows?). Locally, gravel is overlain by brownish-yellow (10YR 6/8) silt that contains root casts 1-2 mm in diameter and tens of centimeters long. Vesicles 0.5 mm in diameter are common. Age of unit is uncertain. Previous workers referred to similar, topographically high, widespread graveliferous deposits in the Mississippi Valley region as Orange Sand, Lagrange,

p. 554). Unit overlies Tertiary bedrock and is 3-27 m thick based on interpretations of drill-Tb Bedrock (Tertiary)—Shown in cross section only. Interbedded sand, silt, clay, and liquite; loosely consolidated. Probably Eocene Jackson Formation or upper part of Eocene Claiborne Group (Kingsbury and Parks, 1993). Unit not exposed in map area, but encountered in most

Upland Gravel, Lafayette Gravel, Citronelle, or the Upland Complex (Autin and others, 1991,

Contact—Solid where relatively certain; dashed where less certain

59 Drill-hole locality and identification number INTRODUCTION

The map locates surficial deposits and materials. Mapping them is the first step to assessing the likelihood that they could behave as a viscous liquid (liquefy) and (or) slump during strong earthquakes. This likelihood depends partly on the physical characteristics of the surficial deposits (Youd, 1991; Hwang and others, 2000), which are described here. Other possible uses of the map include land-use planning, zoning, education, and locating aggregate resources. The Southwest Memphis quadrangle is one of several quadrangles that were mapped recently for these purposes (fig. 1).

The City of Memphis lies within the upper Mississippi embayment, which is seismically active (Schweig and Van Arsdale, 1996) and near the New Madrid Seismic Zone (NMSZ) (fig. 2). Proximity to the NMSZ raises concerns that if earthquakes as strong as those that occurred near New Madrid, Mo., in 1811–1812 were to occur again, life and infrastructure in Memphis would be at risk (Hamilton and Johnston, 1990). The evidences suggestive of a seismic risk for the Memphis Southwest quadrangle are: (1) probable earthquakeinduced liquefaction features (sand dikes) exist in Wolf River alluvium inside Memphis city limits (Broughton and others, 2001), (2) severe damage in the area of present-day Memphis was caused by an 1843 earthquake in the NMSZ, near Marked Tree, Ark. (Stover and Coffman, 1993), and (3) in the mid-continent, earthquake energy waves travel long distances outward from their source, compared to distances of wave transmission from earthquakes of comparable magnitude in California (Johnston and Kanter, 1990; Tuttle and Schweig,

The Southwest Memphis quadrangle is located on loess-covered bluffs and uplands east of the Mississippi River. The loess (QI), mostly the Peoria Loess (Leverett, 1898), covers alluvial sand and gravel of late Tertiary to early Pleistocene age (QTg) that, in turn, overlies the uppermost, soft sandstone of the Clairborne Group (middle Eocene; Tb). The Peoria Loess was deposited widely in the midcontinent region during the late Wisconsinan glaciation and during the coeval aggradational phase of the Mississippi River, 25,000–14,000 years B.P. (Knox, 1996, p. 265). Generally westerly winds deflated copious volumes of silt from the outwash that covered the floodplain and carried it onto the uplands. Subsequently, tributaries to the Mississippi River

have eroded some of the loess and redeposited it as silty alluvium (Qa). The main inaccuracies of the map are our generalized depiction of artificial fill and manmade drainageways, and our interpretations of stratigraphy using drill-hole data previously collected by others. These subjects are discussed in the "Methods" section.

METHODS

Mapping was based on field observations, analysis of color aerial photographs (scale 1:24,000, flown in 1997), topography, and drill-hole data. Grain sizes were estimated using a comparative chart using nomenclature of the modified Wentworth grade scale (American Geological Institute, 1982). Colors of materials were determined by comparison to Munsell Soil Color Charts (Munsell Color, 1973). Geologic ages of the surficial geologic deposits are based on relative and absolute dating techniques and on previous work (Hilgard, 1892; McKay, 1979; Delcourt and others, 1980; Brister and others, 1981; Saucier, 1987; Autin and others, 1991). Relative dating assumes that older deposits are higher than modern stream level and that the soils on them are more fully developed than those on the lower, younger deposits. Radiocarbon-dated fossil material in alluvium of Nonconnah Creek in the adjacent quadrangle to the east (Moore and Diehl, 2004) provides a geochronologic datum (see Qa).

Large areas of the quadrangle have been altered by construction. As a result, the shape of the land surface in such areas differs from that depicted on the topographic base map (1993) and aerial photographs. The artificial fill (af), whose thickness is estimated in cross section, was mapped separately because we speculate that its potential for liquefaction differs from that of the undisturbed geologic deposits. Also it affects risk assessment because it commonly supports buildings and roadways. However, engineering properties of the fill and of the other deposits depicted on the map were not measured. Most artificial fill, except gravelly ballast under railways, is reworked loess (QI).

Boundaries between map units shown on the geologic cross section were interpreted from drill-hole data. Depths to those boundaries were obtained from drill-hole data in the Shelby County Subsurface Database of the Ground Water Institute (GWI), University of Memphis (http://gwidc.gwi.memphis.edu/website/introduction). Those boundaries were "picked" previously by other

geologists using a process that involved interpreting drillers' logs and borehole electrical logs (Ank Webbers, USGS, oral commun., 2000). We used those stratigraphic assignments with little or no modification. The locations of drill holes on the map and cross section have inherent errors. Locations of some holes in the GWI database were determined in the field by previous workers using a global position system; other holes were located using maps and addresses. Most drill-hole locations probably are plotted within a few meters to a hundred meters or more of the actual drill site (Brian Waldron, GWI, written commun., 2002). Plotting the elevations of drill holes in the cross section was more problematic. Elevations of the tops of drill holes recorded in the GWI database (derived from the National Elevation Dataset, NED; Gesch and others, 2002) differed from elevations of the land surface at drill sites as determined by the topographic map. We plotted the latter in the cross section. This required a re-projection of drill-hole locations (from state plane coordinates in the GWI database) to a Transverse Mercater projection, followed by plotting of the new drill-hole locations on the Southwest Memphis 7.5-minute topographic quadrangle.

ACKNOWLEDGMENTS

We thank Roy Van Arsdale, Department of Geological Sciences, University of Memphis, for sharing his geologic knowledge of the area. Joan Gomberg and Buddy Schweig, USGS and Center for Earthquake Research and Information (CERI) at University of Memphis, assisted us in all aspects of the study. We thank Ron Brister, Curator of Collections, Memphis Pink Palace Museum, who pointed us to radiocarbon dates and late Pleistocene climatic data, and who showed us fossils that he and colleagues collected from the Mall of Memphis excavation site in 1980. Richard Dart, USGS, assisted with computer work. Brian Waldron, Ground Water Institute (GWI), University of Memphis, and Kathleen Tucker (CERI) helped us access drill-hole data in the GWI Shelby County Subsurface Database (http://gwint1.gwi.memphis.edu), compiled by Brain Waldron, Howard Hwang, CERI, and Ank Webbers, USGS. Paco Van Sistine, USGS, assisted with cartographic projections. Mary Berger, USGS, provided assistance with graphics. We thank Richard Harrison (USGS) and Derek Booth (University of Washington) for helpful reviews of our work. The U.S. Army Corps of Engineers, Memphis District, provided aerial photographs of the map area.

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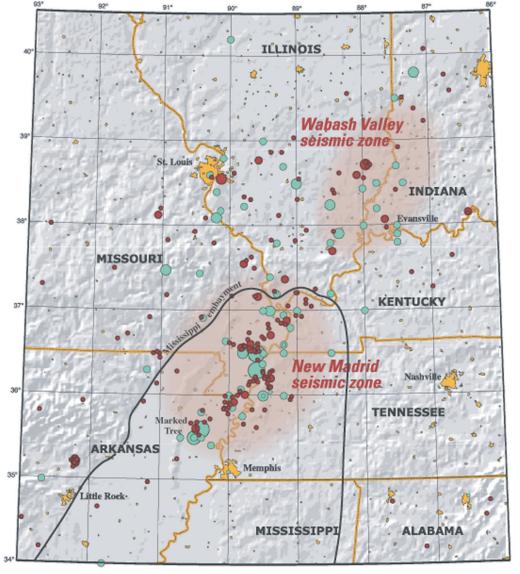


Figure 2. New Madrid and Wabash Valley seismic zones, showing earthquakes as circles. Red, earthquakes that occurred from 1976 to 2002 with magnitudes >2.5, located using modern instruments (University of Memphis). Green, earthquakes that occurred prior to 1974. Larger circle represents larger earthquake. Modified from Gomberg and Schweig (2002).